

X-RAY MICROCOMPUTED TOMOGRAPHY

X4 POSEIDON – Sheep femur with implants

Innovation with Integrity

Orthopedic research involves investigation of the performance of bone implants such as titanium or steel screws, as well as scaffolds of various materials from metals to calcium phosphate to resorbable polymers. Translational testing of such implants requires implantation into animal models followed by testing of how well the implant has integrated into bone.

The powerful 3DxSUITE software package accompanying all Bruker microCT scanners provides a comprehensive solution for both precise analysis of bone status with distance from implant surface to versatile and compelling visualisation and animation solutions. All images in this application note are as always, generated in Bruker 3DxSUITE.

Hong et al (2022) from the School of Dentistry in Seoul National University, South Korea, demonstrated that peri-implant analysis of implant osteointegration by microCT in full 3D was superior to analysis in 2D by histology, due to the geometric limitations and sampling errors introduced by 2D sectioning and analysis. Likewise Zeilinski et al (2024) successfully employed microCT to comparatively evaluate the efficacy of different surface types of dental metal bone implants in a rabbit model.

References:

Hong JM et al. (2022) *PLoS One*, 17(10): e0276269.

Zieliński R et al. (2024) *Materials*, 17(22), 5396.

Scan parameters

- Detector: 7MP flat panel
- Voxel size: 30 μm (1x1 pixel mode)
- Source: Transmission type
- Source power: 110 keV, 16 W
- X-ray filter: 1 mm molybdenum
- Rotation step: 0.12° over 360°

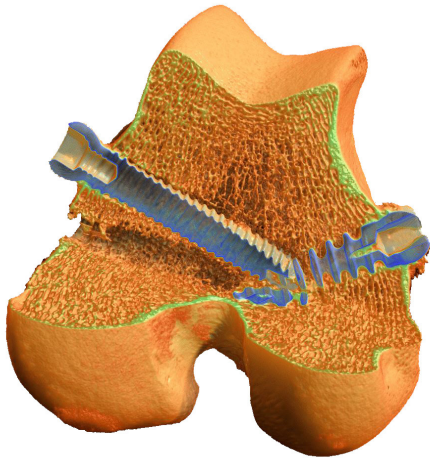


Figure 1: The distal femur of an adult sheep with two titanium screw implants inserted; imaged by the X4 POSEIDON desktop microCT scanner at 30 µm voxel with 1mm molybdenum filter.

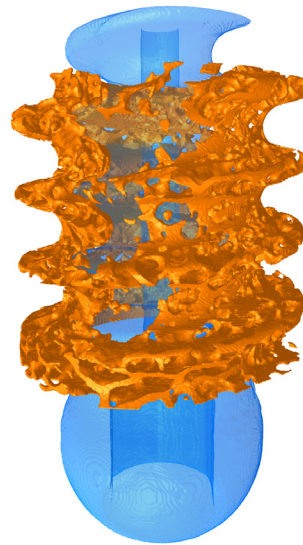


Figure 3: Photo of the adult sheep distal femur condyles.



Figure 2: Section through a titanium screw in the condyle of a sheep femur; minimal density artefacts allow visualisation of undamaged trabeculae between the screw blades.

The high X-ray detection efficiency and low noise performance of the 7Mp flat panel camera in the X4 POSEIDON achieves excellent scan results of large dense samples in a remarkable short time. Combine that with the second X-ray camera in X4 POSEIDON – the 16Mp sCMOS high resolution low noise active pixel sensor, and the whole range of biomaterials, from very low density collagen and PLA/ PLLA/PLGA scaffolds through bone-like mineral materials to metallic prostheses, are all handled by a single microCT imaging workstation.



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